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(54) Title: AQUEOUS FUEL FOR INTERNAL COMBUSTION ENGINE AND METHOD OF COMBUSTION

(57) Abstract

A novel aqueous fuel for an internal combustion engine is provided. The fuel comprises water from about 20 per cent to about 60 per cent by volume of the total volume of said fuel, and a carbonaceous fuel selected from the class consisting of ethanol, methanol, gasoline, diesel fuel or mixtures thereof. A novel method for combusting an aqueous fuel in an internal combustion engine is provided. The method produces approximately as much power as the same volume of gasoline. The method comprises introducing preheated air and said aqueous fuel into a carburetor or fuel injection system, said fuel comprising water from about 20 per cent to about 60 per cent by volume of the total volume of said fuel, and a carbonaceous fuel selected from the group consisting of ethanol, methanol, gasoline, diesel fuel or mixtures thereof, and introducing and combusting said air/fuel mixture in a combustion chamber or chambers in the presence of a hydrogen producing catalyst to operate said engine.

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AQUEOUS FUEL FOR INTERNAL COMBUSTION ENGINE AND METHOD OF COMBUSTION

Field of the Invention

This invention relates to a novel aqueous fuel for an internal combustion engine and to a novel method of combusting such fuel in an internal combustion engine.

Background of the Invention

There is a need for new fuels to replace gasoline for use in internal combustion engines. Internal combustion engines operating on gasoline and diesel fuel produce unacceptably high amounts of pollutants which are injurious to human health and may damage the earth's atmosphere. The adverse effects of such pollutants upon health and the atmosphere have been subject of great public discussion and will not be belabored any further.

Summary of the Invention

A novel fuel and novel method of combustion have been discovered which will reduce pollutants produced by internal combustion engines operated on gasoline. This fuel is also much less expensive than gasoline or diesel fuel because its primary ingredient is water.

The novel fuel of the present invention has about 1/3 the potential energy (BTU's) of gasoline, but when used to operate an internal combustion engine, it will produce approximately as much power as compared with the

same amount of gasoline. This is indeed surprising and is believed to be due to the release and combustion of hydrogen and oxygen when the novel fuel is combusted by the novel method of the present invention.

In its broadest aspects, the aqueous fuel of the present invention comprises substantial amounts of water of up to about 50 to about 60 percent by volume of the total volume of fuel, and a carbonaceous fuel selected from the group consisting of gasoline, ethanol, methanol, diesel fuel, or mixtures thereof. In utilizing this fuel with the novel method of the present invention, combustion air is preheated and introduced into the engine's carburetor or fuel injection system for mixing with the aqueous fuel. When using an engine with a carburetor, the combustion air is preheated to at least about 350°F to about 400°F as it enters the carburetor. When using an engine with a fuel injection system, the combustion air is preheated from about 122°F to about 158°F as it enters the fuel injection system. The air/fuel mixture is then introduced into the combustion chamber or chambers and combusted in the presence of a hydrogen producing catalyst to operate the engine.

<u>Detailed Description of the Preferred Embodiment</u>

The aqueous fuel of the present invention comprises water from about 20 percent to about 50 to 60 percent by volume of the total volume of the fuel and a carbonaceous fuel selected from the class consisting of ethanol, methanol, gasoline, diesel fuel or mixtures thereof. Ethanol and methanol generally contain small percentages of water when produced commercially. Commercial grades of ethanol and methanol are marketed in terms of a proof number, such as for example, 100 proof ethanol. One half the proof number is generally an indication of the amount of ethanol present, i.e., 100 proof ethanol contains 50 percent ethyl alcohol and 50 percent water; 180 proof ethanol contains 90 percent of ethyl alcohol and 10 percent of water, etc.

The aqueous fuel of the present invention is usable in conventional gasoline or diesel powered internal combustion engines for use in automobiles, trucks and the like, using conventional carburetors or fuel injection systems. The only modification necessary to such engines to make them usable with the fuel of the present invention is the installation of a hydrogen producing catalyst in the combustion chamber or chambers of the engine, the installation of a heater to preheat the combustion air for the engine, and the installation of a heat exchanger to use the hot exhaust gases from the engine to preheat the combustion air after the engine is operating, at which time the heater is shut off.

In practicing the method of the present invention, combustion air for the engine is preheated before it is introduced into the carburetor or fuel injection system. When using an engine with a carburetor, the combustion air is preheated to at least about 350°F to about 400°F as it enters the carburetor. When using an engine with a fuel injection system, the combustion air is preheated from about 122°F to about 158°F as it enters the fuel injection system. The aqueous fuel of the present

invention is also introduced into the carburetor or fuel injection system and is mixed with the combustion air. The aqueous fuel may be preheated but is preferably introduced into the carburetor or fuel injection system at ambient temperatures. The air/fuel mixture is then introduced into the combustion chamber or chambers where a spark from a spark plug ignites the air/fuel mixture in the conventional manner when the piston of the combustion chamber reaches the combustion stage of the combustion cycle. The presence of a hydrogen producing catalyst in the combustion chamber and preheated condition of the combustion chamber is believed to liberate hydrogen and/or oxygen from the water in the aqueous fuel when the spark plug ignites the air/fuel mixture. The hydrogen and oxygen are also ignited during combustion to increase the amount of energy delivered by the fuel. Thus, it was observed in experiments using 100 proof alcohol as the engine fuel that the engine produced the same amounts of watts per hour as compared with the same amount of gasoline. This is indeed surprising in view of the fact that the 100 proof ethanol has about 48,000 BTU's per gallon as compared to gasoline, which has about 123,000 BTU's per gallon, nearly three times as much. The fact that the lower BTU ethanol is able to generate as much power as a higher BTU gasoline suggests that additional power must be attributable to the liberation and combustion of hydrogen and/or oxygen from the water.

Inasmuch as 100 proof ethanol has been found to be a satisfactory fuel in using the method of the present invention, it is apparent that other suitable fuels may be made by blending ethanol and/or methanol with gasoline or diesel fuel depending on whether the fuel is to be used in a gasoline or diesel powered engine. Experimental work also indicates that 84 proof (58 percent water) ethanol may also be used as a fuel and it is believed that aqueous fuels containing as much as 70 percent water may be used.

The Engine with Carburetor

To demonstrate the present invention, an engine was selected which also had the capacity to measure a predetermined workload. The engine selected was a one-cylinder, eight horsepower internal combustion engine connected to a 4,000 watt per hour a/c generator. The engine/generator was manufactured by the Generac Corporation of Waukesha, Wisconsin under the tradename Generac, Model No. 8905-0(S4002). The engine/generator is rated to have a maximum continuous a/c power capacity of 4,000 watts (4.0 KW) single phase.

The engine specifications are as follows:

Engine Manufacturer - Tecumseh

Manufacturer's Model No. - HM80 (Type 155305-H)

Rated Horsepower - 8 at 3600 rpm

Displacement - 19.4 cubic inches (318.3 cc)

Cylinder Block Material - Aluminum with cast iron sleeve

Type of Governor - Mechanical, Fixed Speed

Governed Speed Setting - 3720 rpm at No-Load (Rated a/c frequency and voltage (120/240 volts at 62 hertz) are obtained at 3600 rpm. The no-load setting of 3720 rpm provides 124/248 volts at 62 hertz. A slightly high no-load setting helps ensure that engine speed, voltage and frequency do not drop excessively under heavier electrical loading.)

Type of Air Cleaner - Pleated Paper Element

Type of Starter - Manual, Recoil Rope

Exhaust Muffler - Spark Arrestor Type

Ignition System - Solid State with Flywheel Magneto

Spark Plug - Champion RJ-17LM (or equivalent)

Set Spark Plug Gap to - 0.030 inch (0.76mm)

Spark Plug Torque - 15 foot-pounds

Crankcase Oil Capacity - 1-1/2 pints (24 ounces)

Recommended Oil - Use oil classified "For Service SC, SD or SE"

Primary Recommended Oil - SE 10W-30 Multiple Viscosity Oil
Acceptable Substitute - SAE 30 Oil

Fuel Tank Capacity - 1 gallon

Recommended Fuel -

Primary - Clean, Fresh UNLEADED Gasoline
Acceptable Substitute - Clean, Fresh, Leaded REGULAR Gasoline

A heat exchanger was installed on the engine to use the hot exhaust gases from the engine to preheat the air for combustion. A platinum bar was installed to the bottom surface of the engine head forming the top of the combustion chamber. The platinum bar weighed one ounce and measured 2-5/16 inches in length, 3/4 inches in width, and 1/16 inch in thickness. The platinum plate was secured to the inside of the head with three stainless steel screws.

A second fuel tank having a capacity of two liters was secured to the existing one-liter fuel tank. A T-coupling was inserted into the existing fuel line of the motor for communication with the fuel line for each fuel tank. A valve was inserted between the T-coupling and the fuel lines for each fuel tank so that either tank could be used separately to feed fuel to the carburetor or to mix fuels in the fuel line leading to the carburetor.

Test Runs

A series of tests were performed to determine if 100 proof ethanol could be used in the motor which was modified as described above, and if so, to compare the performance of the 100 proof ethanol with the same amount of gasoline.

Two liters of unleaded gasoline were poured into the second fuel tank with the valve for the second tank in the closed position. Three and eight tenths liters of 100 proof ethanol were poured into the one gallon fuel tank with the valve in the closed position. The valve for the gasoline tank was opened so that the engine could be initially started on gasoline.

Within three minutes of starting the motor, the combustion air entering into the carburetor was measured at 180°F. At this point, the fuel valve under the ethanol tank was opened and the valve under the gasoline tank was closed. At that point, the temperature of the air entering the carburetor had risen to 200°F.

Ethanol was now the primary fuel in the motor which exhibited a certain amount of roughness during operation until the choke mechanism was adjusted by reducing the air intake to the engine by approximately 90 percent. Immediately thereafter, two, 1800 watt, heat guns, having a rated heat output of 400°F, were actuated and used to heat the combustion air as it entered the carburetor. The temperature of the air from the heat guns measured 390° to 395°F.

After the engine ran on ethanol for approximately 20 minutes, the heat measurement in the incoming combustion air stabilized between 347°F and 352°F. The engine was run on the 100 proof ethanol fuel for 40 additional minutes, for a total of one hour, until two liters of ethanol had been used. The valve under the ethanol tank was then closed and the engine was turned off by opening the choke. Eighteen hundred milliliters of ethanol were left remaining in the tank.

The choke was then reset to the 90 per cent closed position, and the engine was started once again. The engine responded immediately and ran as smoothly on 100 proof ethanol as it did during the one-hour operation.

The engine was stopped and started in the same manner on three separate occasions thereafter with the same results.

While operating the engine on 100 proof ethanol, the power output on the generator was measured and indicated that the ethanol produced 36,000 watts during a one-hour period using two liters of ethanol having 48,000 BTUs per gallon.

After the engine had stopped running on ethanol, it was operated again with the two liters of gasoline in the gasoline tank. 47 minutes into the test, the engine stopped because it ran out of gasoline. Measurements taken on the generator indicated that, when the engine was operated on gasoline, it was producing power at a rate of 36,000 watts per hour for 47 minutes, using two liters of gasoline having 123,000 BTUs per gallon.

Comparing these power measurements indicates that two liters of 100 proof ethanol produces the same amount of power as two liters of gasoline. This is surprising inasmuch as the gasoline has about 2.5 times as many BTUs as the same amount of 100 proof ethanol. This indicates that the extra power from the ethanol must be due to the liberation and combustion of hydrogen and/or oxygen from the relatively large amounts of water in the fuel.

Although gasoline was used as the starter fuel to preheat the engine and, thus, generate hot exhaust gases to preheat the combustion air, the use of the gasoline as the starter fuel is not necessary and could be replaced with an electrical heat pump to preheat the combustion air until the heat exchanger could take over and preheat the combustion air, whereupon the electrical heat pump would turn off.

The above tests comparing the use of the 100 proof ethanol and gasoline were repeated on three subsequent occasions, each with the same results.

A second series of tests were run which were identical to the above, except for the use of 84 proof

ethanol (42 per cent ethyl alcohol and 58 per cent water) in place of the 100 proof ethanol. However, after running about 30 seconds on the 84 proof ethanol, the engine stopped abruptly and released a fair amount of oil under high pressure from the main bearing in the main engine. The engine was restarted and abruptly stopped again after operating for about 20 seconds.

The above stoppage appears to have been due to preignition of the hydrogen and/or oxygen during the up-stroke period of the piston which caused pressure build-up in the crank case, which in turn forced oil under pressure through the main bearing. The pressure inside the combustion chamber appears to have been relieved through the piston rings into the crank case, and then relieved through the main bearing.

The premature ignition of the hydrogen and/or oxygen was probably caused by generating a larger amount of oxygen and hydrogen which did not occur when using 100 proof ethanol having a lesser amount of water.

The preignition problem can probably be cured by using an engine having a shorter piston stroke to reduce the dwell time of the fuel, including hydrogen and oxygen, in the combustion chamber, or by adjusting the carburetor or the electronically controlled fuel injection system to help reducing dwell time to avoid generating excessive amount of hydrogen and oxygen. The engine used in the experiment had a relatively long piston stroke of 6 inches. The piston stroke should be no more than about 1 1/2 inches or less to avoid the preignition problem in that particular engine.

ENGINE WITH ELECTRONICALLY CONTROLLED FUEL INJECTION SYSTEM

A series of tests were run on an engine having an electronically controlled fuel injection system to determine if that would solve the preignition problem discussed above. The engine used for this purpose was a 3-cylinder turbo charge electronically controlled internal

combustion engine from a 1987 Chevrolet Sprint which had been driven about 37,000 miles.

The head from the motor block was removed and cleaned to remove carbon deposits. Three platinum plates were attached to the inside of each head so as not to interfere with valves moving inside the heads during operation. Each platinum plate was 1 centimeter in length and width and was 1/32 of an inch in thickness. Each platinum plate was attached to the head with one stainless steel screw through the center of each piece. Carbon deposits were cleaned off each piston head and the engine was reassembled using new gaskets.

The combustion air intake hose which exits from the turbo and leads to the injector module is divided in the middle and attached to a heat exchanger to cool the combustion air delivered to the injector. The heat exchanger was bypassed by using two Y junctions on either side of the heat exchanger and by putting a butterfly valve on the side closest to the turbo so that the hot air stream could be diverted around the heat exchanger and introduced directly into the injector module. All pollution abatement equipment was removed from the engine but the alternator was kept in place. The transmission was reattached to the engine because the starter mount is attached to the transmission. The transmission was not used during the testing. This engine was inserted into a Chevrolet Sprint car having a tailpipe and muffler system which was necessary for the engine to run properly. The catalytic converter was left in the exhaust train but the inside of the converter was removed as it was not needed. Two one gallon plastic fuel tanks were hooked up to the fuel pump by a T-section having manual valves so the fuel to the fuel pumped could be quickly changed by opening or closing the valves.

TEST RUNS

A series of test runs were performed to determine how the engine as modified above would run using a variety of fuels.

The first test utilized 200 proof methanol as a starter fluid. The engine started and operated when the fuel pressure was raised to 60 to 75 lbs. When using gasoline, the fuel pressure is generally set at 3.5 to 5 lbs.

While the engine was running on the 200 proof methanol, the fuel was changed to 100 proof denatured ethanol and the motor continued operating smoothly at 3500 revolutions per minute (rpm). After about two minutes the test was stopped and the engine shut down because the fuel hoses were bulging and became unsafe. These hoses were replaced with high pressure hoses and the plastic couplings and the T's were also replaced with copper couplings and T's. A new pressure gage was attached. During the testing, it was noted that the fuel mixture need more combustion air and that the computerized settings of the engine could not be adjusted to provide the additional air. To overcome this, the air intake valve was opened.

After these modifications, a new series of tests were performed using 200 proof methanol in one of two fuel tanks. The engine started on the 200 proof methanol and the rpm setting was adjusted to 3500. The engine was allowed to run for a few minutes. During that time, the fuel pressure was adjusted and it was noted that 65 lbs. of pressure appeared to be adequate. A thermocouple was inserted close to the injector module and provided a reading of 65°C after about 5 minutes.

A fuel mixture comprising 500 ml of distilled water and 500 ml of 200 proof methanol were put into the second fuel tank and was used to operate the engine. Without changing the air flow, the temperature of the combustion air rose from 65 to 75°C after about 1 minute. The rpm

reading dropped to 3100 rpm. The engine ran very smoothly and was turned off and restarted without difficulty.

The next step in the test series was to determine how variations in the water content of the fuel effected engine performance. Using 199 proof denatured ethanol as starter fuel, the engine started immediately. The fuel pressure setting was reduced from 65 lbs. to 50 lbs, the combustion air measured 65°C, the rpm's measured 3500, and the engine ran smoothly.

The fuel was then changed into 160 proof denatured ethanol. The fuel pressure was maintained at 50 lbs. The combustion air temperature was measured at 67°C, the rpm's decreased to 3300, and the engine ran smoothly.

After 10 minutes, the fuel was changed to 140 proof denatured ethanol. The combustion air temperature rose to 70°C, the rpm's rose to 3500, and the engine ran smoothly.

After 10 minutes, the fuel was changed to 120 proof denatured ethanol. The combustion air temperature increased to 73°C, the rpm's decreased to 3300, and the engine ran smoothly.

After 10 minutes, the fuel was changed to 100 proof denatured ethanol. The combustion air temperature increased to 74°C, the rpm's decreased to 3100, and the engine ran smoothly.

After 10 minutes, the fuel was changed to 90 proof denatured ethanol. The combustion air temperature remained at 74°C, the rpm's reduced to 3100, and the engine ran smoothly.

After 10 minutes, the fuel was changed to 80 proof denatured ethanol. The combustion air temperature raised to 76°C and the rpm's reduced to 2900. At that point, an infrequent backfire was noted in the engine. 100 proof denatured ethanol was then used as the primary fuel and the bypass to the heat exchanger was closed. The combustion air temperature rose to 160°C and during the

next minutes increased to 170°C. The rpm's increased to 4000 rpm and the engine ran smoothly.

Another series of tests were run with the engine adjusted to operate at 3500 rpm's and with the heat exchanger removed. The engine was started with 200 proof ethanol as the fuel and as soon as the intake air temperature at the injector module had risen to about 50°C, the fuel was changed to 100 proof ethanol and the engine ran smoothly. The intake air temperature rose to 70°C where it stabilized. The engine was turned off, restarted and continued to run smoothly. By adjusting and opening the air intake, the rpm could be increased to over 4000. By slightly closing the same air intake, the rpm could be reduced to 1500. At both ranges of rpm, the engine ran smoothly and was turned off and restarted without difficulty and continued to run smoothly.

The rpm of an engine using the method and fuel of the present invention may be regulated by regulating the amount of air flow into the combustion chamber. In a convention gasoline powered engine, the engine rpm is regulated by regulating the amount of gasoline that is introduced into the combustion chambers.

Gaseous fuels such as methane, ethane, butane or natural gas and the like could be liquified and substituted for ethanol and methanol used in the present invention.

The present invention could also be used in jet engines, which is another form of internal combustion engine.

While the embodiment of the invention chosen herein for purposes of the disclosure is at present considered to be preferred, it is to be understood that this invention is intended to cover all changes and modifications of all embodiments which fall within the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A novel aqueous fuel for an internal combustion engine, said fuel comprising water from about 20 per cent to about 60 per cent by volume of the total volume of said fuel, and a carbonaceous fuel selected from the class consisting of ethanol, methanol, gasoline, diesel fuel or mixtures thereof.

2. The novel aqueous fuel as set forth in claim 1, said fuel comprising water from about 20 per cent to about 50 per cent by volume of the total volume of said fuel.

3. The novel aqueous fuel as set forth in claims 1 or 2 wherein said carbonaceous fuel is selected from the class consisting of ethanol, methanol or mixtures thereof.

4. The novel aqueous fuel as set forth in claims 1 or 2 wherein said carbonaceous fuel is selected from the class consisting of ethanol, gasoline or mixtures thereof.

5. The novel aqueous fuel as set forth in claims 1 or 2 wherein said carbonaceous fuel is ethanol.

6. A method for combusting an aqueous fuel in an internal combustion engine to produce approximately as much power as the same volume of gasoline, said internal combustion engine being capable of producing a range of engine revolutions per minute (rpm) and having one or more combustion chambers and a carburetor or a fuel injection system for mixing said fuel and air and introducing said mixture into said combustion chamber or chambers, said method comprising:

preheating said air for combustion and introducing said preheated air into said carburetor or fuel injection system,

introducing said aqueous fuel into said carburetor or fuel injection system to mix with said combustion air, said fuel comprising water from about 20 per cent to about 60 per cent by volume of the total volume of said fuel, and a carbonaceous fuel selected from the group consisting of ethanol, methanol, gasoline, diesel fuel or mixtures thereof, and

introducing and combusting said aqueous fuel and combustion air in said combustion chamber or chambers in the presence of a hydrogen-producing catalyst to operate said engine.

7. The method as set forth in claim 6 wherein said fuel comprises water from about 20 per cent to about 50 per cent by volume of the total volume of said fuel.

8. The method as set forth in claim 6 or 7 wherein said carbonaceous fuel is selected from the group consisting of gasoline, ethanol, or mixtures thereof.

9. The method as set forth in claim 6 or 7 wherein said carbonaceous fuel is selected from the class consisting of ethanol, methanol or mixtures thereof.

10. The method as set forth in claims 6 or 7 wherein said carbonaceous fuel is ethanol.

11. The method as set forth in claims 6 or 7 wherein said combustion air is initially heated by a heater and then heated by heat from hot exhaust gases from said engine after the engine is operating.

12. The method as set forth in claims 6 or 7 wherein said catalyst is selected from the class consisting of platinum, platinum nickel alloy, nobel metals, and other materials that will produce hydrogen when said combustion air and said aqueous fuel are combusted over said catalyst.

13. The method as set forth in claims 6 or 7 wherein said catalyst is platinum.

14. The method as set forth in claims 6 or 7 wherein said air is preheated to at least about 350°F to about 400°F as said air enters said carburetor.

15. The method as set for in claims 6 or 7 wherein said air is preheated from 122°F to about 158°F as said air enters said fuel injection system

16. The method as set forth in claims 6 or 7 wherein said aqueous fuel is introduced into said carburetor or said fuel injection system at ambient temperatures.

17. The method as set forth in claims 6 or 7 wherein said rpm's are regulated by regulating the air flow into the carburetor or fuel injection system.

AMENDED CLAIMS
[received by the International Bureau on 22 April 1991 (22.04.91); new claims 18-37 added; other claims unchanged (5 pages)]

18. A novel aqueous fuel combustible with air in an internal combustion engine, said fuel comprising a carbonaceous fuel and water in an amount of from greater than 20 percent to about 60 to 70 percent by volume of the total volume of said fuel.

19. The novel aqueous fuel as set forth in claim 18 wherein said carbonaceous fuel is selected from the class consisting of ethanol, methanol, gasoline, diesel fuel or mixtures thereof.

20. A method for combusting an aqueous fuel in an internal combustion engine having (a) one or more combustion chambers, (b) a fuel introduction system for receiving and mixing fuel and combustion air and introducing said fuel and air mixture into said combustion chamber or chambers and (c) an electric spark producing system for creating a spark in said combustion chamber or chambers, said method comprising:

introducing combustion air in controlled amounts into said fuel introduction system,

introducing aqueous fuel into said fuel introduction system to mix with said combustion air, said aqueous fuel comprising water from about 20 percent to about 60 to 70 percent by volume of the total volume of said fuel, and a carbonaceous fuel selected from the group consisting of ethanol, methanol, gasoline, diesel fuel, or mixtures thereof, and

introducing and combusting said aqueous fuel and combustion air in said combustion chamber or chambers in the presence of a hydrogen-producing catalyst to operate said engine, said combustion being initiated by a spark generated in said combustion chamber or chambers.

21. The method as set forth in claim 20 wherein said catalyst is selected from the class consisting of nickel, platinum, platinum-nickel alloy, noble metals, alloys thereof, and other materials that will dissociate water molecules to produce hydrogen when said combustion air and said aqueous fuel are combusted in the presence of said catalyst and an electric spark.

22. A method according to claim 20 wherein water molecules in the aqueous fuel are dissociated in said combustion chamber or chambers to release hydrogen and oxygen and wherein said hydrogen is combusted in said combustion chamber along with carbonaceous fuel.

23. The method as set forth in claim 20 wherein the power output of the engine is regulated by regulating the flow of air for combustion into the fuel introduction system.

24. The method as set forth in claim 20 wherein said combustion air is initially heated prior to induction to the combustion chamber by a heater and then heated by heat from hot exhaust gases from said engine after the engine is operating.

25. The method as set forth in claim 20 wherein said fuel introduction system includes a carburetor and said air is preheated to at least about 350°F to about 400°F as said air enters said carburetor.

26. The method as set for in claim 20 wherein said fuel introduction system includes a fuel injection system and said air is preheated to at least 122°F as said air enters said fuel injection system

27. A method for combusting an aqueous fuel comprising a mixture of carbonaceous fuel and water in

an internal combustion engine, said combustion being capable of producing approximately at least as much engine power as the same volume of said carbonaceous fuel would produce in said engine without water and a range of power output as indicated by a corresponding range of engine revolutions per minute (rpm), said engine having one or more combustion chambers, an electric spark producing system for creating a spark in said combustion chamber or chambers, and a fuel introduction system for (a) receiving and mixing said fuel with air for combustion, (b) controlling the proportions of fuel and air, and (c) introducing said fuel and air mixture into said combustion chamber or chambers, said method comprising:

introducing aqueous fuel and controlled amounts of combustion air to said fuel introduction system for mixing therein, said aqueous fuel comprising water from about 20 percent to about 70 percent by volume of the total volume of said fuel and a liquid or gaseous carbonaceous fuel,

introducing said mixture of aqueous fuel and combustion air into said combustion chamber or chambers in the presence of a hydrogen-producing catalyst in said combustion chamber or chambers; and

combusting said aqueous fuel and air mixture to operate said engine, said combustion being initiated by a spark generated in said combustion chamber or chambers.

28. A method according to claim 27 wherein water molecules in the aqueous fuel are dissociated in said combustion chamber or chambers to release hydrogen and oxygen and wherein said hydrogen is combusted in said combustion chamber along with carbonaceous fuel.

29. The method as set forth in claim 27 wherein said carbonaceous fuel is selected from the group

consisting of alcohols, gasoline, diesel fuel, and mixtures thereof.

30. The method as set forth in claim 27 wherein said hydrogen producing catalyst is selected from the group consisting of nickel, platinum, platinum-nickel, noble metals, alloys thereof, and other materials that will produce hydrogen when said combustion air and said aqueous fuel are combusted in the presence of said catalyst and an electrically generated spark.

31. The method as set forth in claim 27 wherein said combustion air is initially heated by a heater and then heated by heat from hot exhaust gases from said engine after the engine is operating.

32. The method as set forth in claim 27 wherein said fuel introduction system comprises a carburetor and said air is preheated to at least about 350°F prior to entry into said carburetor.

33. The method as set for in claim 27 wherein said fuel introduction system comprises a fuel injection system said air is preheated at least about 122°F prior to entry into said fuel injection system.

34. A fuel mixture for combustion in a combustion chamber in an internal combustion engine comprising aqueous fuel, gaseous or liquid carbonaceous fuel and hydrogen, said aqueous fuel comprising water in an amount of from 20% to 70% by volume of the total volume of said aqueous fuel.

35. A fuel mixture according to claim 34 wherein said carbonaceous fuel comprises ethanol, methanol, gasoline, diesel fuel, or mixtures thereof.

36. A method of operating an internal combustion engine in a motor vehicle said internal combustion engine being capable of producing a range of power output as indicated by a corresponding range of engine revolutions per minute (rpm) and having one or more combustion chambers, an electric spark producing system for creating a spark in said combustion chamber or chambers, and a fuel introduction system for (a) receiving and mixing fuel with air, (b) controlling the proportions of fuel and air and (c) introducing said fuel and air mixture into said combustion chamber or chambers, said method comprising:

introducing combustion air in controlled amounts into said fuel introduction system,

introducing aqueous fuel into said fuel introduction system to mix with said combustion air, said aqueous fuel comprising water from about 20 percent to about 70 percent by volume of the total volume of said fuel, and a liquid or gaseous carbonaceous fuel selected from the group consisting of alcohols, gasoline, diesel fuel or mixtures thereof, and

introducing and combusting said aqueous fuel and combustion air in said combustion chamber or chambers in the presence of a hydrogen-producing catalyst to operate said engine, said combustion being initiated by a spark generated in said combustion chamber or chambers.

37. A method according to claim 36 wherein water molecules in the aqueous fuel are dissociated in said combustion chamber or chambers to release hydrogen and oxygen and wherein said hydrogen is combusted in said combustion chamber along with carbonaceous fuel.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US90/06395

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC
INT. CL. (5) F02D 19/00
U.S. CL.: 123/25R;1A

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	123/1A; 25R; 25D 44/52

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	US, A, 4,831,971 23 MAY 1989 (OTT et al)	1-17
Y	US, A, 4,333,739 08 JUNE 1982 (NEVES)	1-17
A	US, A, 4,594,991 17 JUNE 1986 (HARVEY)	1-17
A	US, A, 4,476,817 16 OCTOBER 1984 (LINDBERG)	1-17
A	US, A, 2.460,700 01 FEBRUARY 1949 (LYONS)	1-17
A	US, A, 4,563,982 14 JANUARY 1986 (PISCHINGER)	1-17

* Special categories of cited documents: [15]
"A" document defining the general state of the art which is not considered to be of particular relevance
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
14 DECEMBER 1990	21 FEB 1991
International Searching Authority [1]	**Signature of Authorized Officer**
ISA/US	NGUYEN NGOC-HO INTERNATIONAL DIVISION For E. ROLLINS CROSS Ngoc Ho Nguyen